

In the Claims

1.-22. (Cancelled)

23. (New) A solid-oxide fuel cell using a metallic material for fuel cells comprising:
0.006 percent by mass or less of C;
0.02 to 0.13 percent by mass of Si;
2.0 percent by mass or less of Mn;
19.65 to 20.45 percent by mass of Cr;
0.11 to 5.0 percent by mass of Mo;
0.21 to 3.0 percent by mass of Nb;
at least one element selected from the group consisting of Sc, Y, La, Ce, Pr, Nd, Pm, Sm, Zr, and Hf in a total of 0.03 to 1.0 percent by mass; and
the balance composed of Fe and inevitable impurities;
wherein $0.3 \leq \text{Mo/Nb} \leq 9.57$ is satisfied, and further comprising a precipitate containing Fe, Cr and Si at contents on the basis of the metallic material satisfying the following equation (1):
[precipitated Fe]+[precipitated Cr]+[precipitated Si] ≥ 0.01 percent by mass ... (1)
wherein,
[precipitated Fe]: content (percent by mass) of Fe in the precipitate;
[precipitated Cr]: content (percent by mass) of Cr in the precipitate; and
[precipitated Si]: content (percent by mass) of Si in the precipitate, and the metallic material;
wherein,
when in use at a cell operating temperature of 800°C for at least 1,000 hours or more, the Fe, Cr and Si contents in the precipitate on the basis of the metallic material satisfy the following equation (2):
[precipitated Fe]+[precipitated Cr]+[precipitated Si] ≥ 0.03 percent by mass ... (2)
wherein,
[precipitated Fe]: content (percent by mass) of Fe in the precipitate;
[precipitated Cr]: content (percent by mass) of Cr in the precipitate; and
[precipitated Si]: content (percent by mass) of Si in the precipitate.

24. (New) The fuel cell according to claim 23, wherein the metallic material for fuel cells is a hot-rolled material.

25. (New) The fuel cell according to claim 23, wherein the metallic material for fuel cells is a cold-rolled material.

26. (New) The fuel cell according to claim 24, wherein the metallic material is further subjected to a precipitation treatment so that the Fe, Cr and Si contents in the precipitate on the basis of the metallic material satisfy the following equation (3):

$$[\text{precipitated Fe}] + [\text{precipitated Cr}] + [\text{precipitated Si}] \geq 0.02 \text{ percent by mass} \dots (3)$$

wherein,

[precipitated Fe]: content (percent by mass) of Fe in the precipitate;

[precipitated Cr]: content (percent by mass) of Cr in the precipitate; and

[precipitated Si]: content (percent by mass) of Si in the precipitate.

27. (New) The fuel cell according to claim 25, wherein the metallic material is further subjected to a precipitation treatment so that the Fe, Cr and Si contents in the precipitate on the basis of the metallic material satisfy the following equation (3):

$$[\text{precipitated Fe}] + [\text{precipitated Cr}] + [\text{precipitated Si}] \geq 0.02 \text{ percent by mass} \dots (3)$$

wherein,

[precipitated Fe]: content (percent by mass) of Fe in the precipitate;

[precipitated Cr]: content (percent by mass) of Cr in the precipitate; and

[precipitated Si]: content (percent by mass) of Si in the precipitate.

28. (New) A method for producing a metallic material for fuel cells comprising:
re-heating a steel material, if required;
hot-rolling the steel material; and, if required,
annealing and pickling the hot-rolled sheet;
cold rolling the steel material;
annealing the steel material;

wherein the steel material is adjusted to contain:

0.006 percent by mass or less of C;
0.02 to 0.13 percent by mass of Si;
2.0 percent by mass or less of Mn;
19.65 to 20.45 percent by mass of Cr;
0.11 to 5.0 percent by mass of Mo;
0.21 to 3.0 percent by mass of Nb;

at least one of element selection from Sc, Y, La, Ce, Pr, Nd, Pm, Sm, Zr, and Hf in a total of 0.03 to 1.0 percent by mass; and

the balance composed of Fe and inevitable impurities; and

$0.3 \leq \text{Mo/Nb} \leq 9.57$ is satisfied, and wherein the metallic material for fuel cells further comprises a precipitate containing Fe, Cr and Si at contents on the basis of the metallic material satisfying the following equation (1):

$$[\text{precipitated Fe}] + [\text{precipitated Cr}] + [\text{precipitated Si}] \geq 0.01 \text{ percent by mass} \dots (1)$$

wherein,

[precipitated Fe]: content (percent by mass) of Fe in the precipitate;

[precipitated Cr]: content (percent by mass) of Cr in the precipitate;

[precipitated Si]: content (percent by mass) of Si in the precipitate; and

pressing the resulting metallic material for fuel cells.

29. (New) The method according to claim 28, further comprising pickling after annealing the cold rolled steel material.

30. (New) The method according to claim 28, further comprising performing a precipitation treatment of the metallic material for fuel cells so that the Fe, Cr and Si contents in the precipitate on the basis of the metallic material satisfy the following equation (3):

$$[\text{precipitated Fe}] + [\text{precipitated Cr}] + [\text{precipitated Si}] \geq 0.02 \text{ percent by mass} \dots (3)$$

wherein,

[precipitated Fe]: content (percent by mass) of Fe in the precipitate;

[precipitated Cr]: content (percent by mass) of Cr in the precipitate; and

[precipitated Si]: content (percent by mass) of Si in the precipitate.

31. (New) A metallic material for fuel cells comprising:

0.006 percent by mass or less of C;

0.02 to 0.13 percent by mass of Si;

2.0 percent by mass or less of Mn;

19.65 to 20.45 percent by mass of Cr;

0.11 to 5.0 percent by mass of Mo;

0.21 to 3.0 percent by mass of Nb;

at least one element selected from the group consisting of Sc, Y, La, Ce, Pr, Nd, Pm, Sm, Zr,

and Hf in a total of 0.03 to 1.0 percent by mass; and

the balance composed of Fe and inevitable impurities;

wherein $\leq 0.3 \leq \text{Mo/Nb} \leq 9.57$ is satisfied, and further comprising a precipitate containing Fe, Cr and Si at contents on the basis of the metallic material satisfying the following equation (1):

$$[\text{precipitated Fe}] + [\text{precipitated Cr}] + [\text{precipitated Si}] \geq 0.01 \text{ percent by mass} \dots (1)$$

wherein,

[precipitated Fe]: content (percent by mass) of Fe in the precipitate;

[precipitated Cr]: content (percent by mass) of Cr in the precipitate; and

[precipitated Si]: content (percent by mass) of Si in the precipitate, and the metallic material;

wherein,

when in use at a cell operating temperature of 800°C for at least 1,000 hours or more, the Fe, Cr and Si contents in the precipitate on the basis of the metallic material satisfy the following equation (2):

$$[\text{precipitated Fe}] + [\text{precipitated Cr}] + [\text{precipitated Si}] \geq 0.03 \text{ percent by mass} \dots (2)$$

wherein,

[precipitated Fe]: content (percent by mass) of Fe in the precipitate;

[precipitated Cr]: content (percent by mass) of Cr in the precipitate;

[precipitated Si]: content (percent by mass) of Si in the precipitate; and

corrugating the metallic material for fuel cells.

32. (New) The fuel cell according to claim 23, having an electrical resistance of about 30 m Ω cm² or less at 800° C.

33. (New) The fuel cell according to claim 23, wherein the precipitate contains Mo and Nb combined with Fe, Cr and Si in grain boundaries of the metallic material.

34. (New) The method according to claim 28, wherein the precipitate contains Mo and Nb combined with Fe, Cr and Si in grain boundaries of the metallic material.